THE INVENTION CLAIMED IS:

1. A computer-implemented method for determining component placement in a circuit comprising:

(a) receiving a plurality of components, with each component having associated therewith a width, a height and one of a symmetric and a non-symmetric placement constraint;

(b) creating a tree structure that expresses the placement constraints for the plurality of components, the tree structure including:

a global root node that represents a global symmetry line,

a leaf representing each component, with the component associated with each leaf tagged for placement on a first side, a second side, or on both sides of the global symmetry line, and

at least one interior node that represents a slicing line that establishes a relative placement of at least two components with respect to each other on the same side of the global symmetry line;

(c) performing at least one structured search of the tree structure to determine the initial placement of components on the first side, the second side or both sides of the global symmetry line based on the tagging of each component and the connections of the leaves, the global root node and the interior nodes to form the tree structures; and

(d) performing another structured search of the tree structure to determine the final placement of components based on at least one of the widths and heights of the components.

2. The method of claim 1, wherein each structured search is a depth-first search.

3. The method of claim 1, wherein:

each slicing line has a direction that is one of parallel and perpendicular to the global symmetry line; and

step (c) includes the placement of said at least two components with respect to each other as a function of the direction of the slicing line.

4. The method of claim 1, wherein step (c) includes, for components tagged for placement on the same side of the global symmetry line, placing a component associated with a leaf positioned lower in the tree structure closer to the global symmetry line than a component associated with a leaf positioned higher in the tree structure.

5. The method of claim 1, wherein:

each node has a pair of branches descending therefrom; and

each branch couples the node from which it descends to (1) one of the interior nodes, (2) one of the leaves, or (3) a null.

6. The method of claim 5, wherein step (c) includes, for an interior node that represents a slicing line that is parallel to the global symmetry line:

placing on one side of the global symmetry line, a first component which is tagged for such placement and which is represented by a leaf which is connected to said interior node via one of its branches; and

placing on a side of the first component opposite the global symmetry line a second component which is tagged for placement on the one side of the global symmetry line and which is represented by a leaf which is connected to said interior node via the other of its branches.

7. The method of claim 6, wherein at least one of the leaves representing the first and the second components is connected directly to said interior node.

8. The method of claim 5, wherein step (c) includes, for the global root node:

placing a first component which is tagged for placement on one side of the global symmetry line and which is represented by a leaf which is connected to said global root node via one of its branches; and

placing on a side of the first component opposite the global symmetry line, a second component which is tagged for placement on the one side of the global symmetry line and which is represented by a leaf which is connected to said global root node via the other of its branches.

9. The method of claim 8, wherein at least one of the leaves representing the first and second components is connected directly to said global root node.

10. The method of claim 5, wherein step (c) includes, for an interior node that represents a slicing line that is perpendicular to the global symmetry line:

placing on one side of the global symmetry line, a first component which is tagged for such placement and which is represented by a leaf which is connected to said interior node via one branch descending therefrom; and

placing one of above and below the first component, a second component which is tagged for placement on the one side of the global symmetry line and which is represented by a leaf which is connected to said interior node via the other branch descending therefrom.

11. The method of claim 5, wherein step (d) includes placing one edge of a component adjacent the global symmetry line when the leaf representing said component is one of:

connected to a node at the lowest level of the tree structure via one branch descending from said node; or

connected to said node via the other branch descending therefrom and no other leaf is connected to said interior node via the one branch descending therefrom.

12. The method of claim 5, wherein, for each component tagged for placement on both sides of the global symmetry line in a pair-symmetric manner, step (c) includes placing first and second copies of said component on the respective first and second sides of the global symmetry line, with each copy of the component having a side closest to the global symmetry line positioned a distance D therefrom.

13. The method of claim 12, wherein the distance D is one of:

zero when the leaf representing the component tagged for pair-symmetric placement is connected directly to a node at the lowest level of the tree structure; or

the greater of (1) a sum of the width(s) or height(s) of each component placed on the first side of the global symmetry line prior to placement of copies of the component tagged for pair-symmetric placement or (2) a sum of the width(s) or height(s) of each component placed on the second side of the global symmetry line prior to placement of copies of the component tagged for pair-symmetric placement.

14. The method of claim 1, wherein, for each component tagged for placement on both sides of the global symmetry line in a self-symmetric or asymmetric manner, step (c) includes placing a first part of said component on the first side of the global symmetry line and placing a second part of said component on the second side of the global symmetry line.

15. The method of claim 14, wherein:

for each component tagged for self-symmetric placement, the first part of the component is one-half of the component and the second part of the component is the other half of the component; and

for each component tagged for asymmetric placement, the first part of the component is a first percentage of said component, the second part of the component is a second percentage of said component, and the sum of the first and second percentages equal one-hundred percent.

16. The method of claim 1, wherein, for each component tagged for offset symmetric placement on one side of the global symmetry line a distance D from the global symmetry line, step (c) includes placing said component on the one side of the global symmetry line with the side of the component in opposition with the global symmetry line positioned the distance D from the global symmetry line.

17. The method of claim 1, further including:

defining an isolation structure along at least one side of at least one component; and

in step (d), placing the one side of said at least one component no closer to another component or the global symmetry line than said isolation structure.

18. The method of claim 1, further including:

amending the tree structure in at least one of the following manners:

(1) changing a direction of at least one slicing line;

(2) re-tagging at least one component from placement on the first side of the global symmetry line to placement on the second side of the global symmetry line, or vice versa;

(3) exchanging the location of two components in the tree structure;

(4) exchanging the location of one leaf and one interior node, and any interior node and/or leaf connected to said one interior node; and

(5) exchanging the width and height of a component associated with at least one leaf;

and

repeating steps (c) and (d) for the amended tree structure.

19. The method of claim 1, wherein:

the tree structure includes a group which is tagged for placement on the first side, the second side, or both sides of the global symmetry line;

the group includes a group tree structure having at least one leaf connected to a local root node that represents a local symmetry line;

the component associated with each leaf of the group tree structure is tagged for placement on a first side, a second side, or on both sides of the local symmetry line; and

the method further includes:

performing at least one structured search of the group tree structure to determine an initial placement of each component thereof on the first side, the second side or both sides of the local symmetry line based on the tagging thereof; and

performing another structured search of the group tree structure to determine a final placement of each component thereof based on at least one of the widths and the heights of the components.

20. The method of claim 19, wherein:

the group tree structure includes at least one local interior node connected between the local root node and the at least one leaf; and

the step of performing at least one structured search of the group tree structure includes placing at least two components associated with the group tree structure with respect to each other as a function of a direction of a slicing line represented by the at least one local interior node of the group tree structure.

21. The method of claim 19, wherein:

step (c) includes performing the at least one structured search of the tree structure to determine the initial placement of the group on the first side, the second side, or both sides of the global symmetry line based on the tagging thereof; and

step (d) includes performing the other structured search of the tree structure to determine the final placement of the group.

22. The method of claim 21, wherein step (d) includes substituting for the final placement of the group the final placement of the components associated therewith.

23. The method of claim 22, wherein, at least one of:

the local root node is connected directly to either the root node or one of the interior nodes of the tree structure; or

the at least one leaf of the group tree structure is connected directly to the local root node.

24. A computer-implemented method for determining component placement in a circuit comprising:

(a) receiving a plurality of components each having one of a symmetric and a non-symmetric placement constraint associated therewith;

(b) creating a tree structure that expresses the placement constraints for the plurality of components, the tree structure including a plurality of nodes and a plurality of leaves wherein:

the plurality of nodes includes a global root node that represents a global symmetry line and a local root node connected to the global root node,

the local root node represents a local symmetry line,

a group tree structure including the local root node and at least one leaf connected thereto is tagged for placement on a first side, a second side or on both sides of the global symmetry line, and

each leaf represents one of the components, with the component associated with each leaf of the group tree structure tagged for placement on a first side, a second side or on both sides of the local symmetry line, with the component associated with each leaf of the group tree structure having at least one of a height and a width associated therewith;

(c) performing at least one structured search of the group tree structure to determine the initial placement of components thereof on the first side, the second side or both sides of the local symmetry line based on the tagging of each component; and

(d) performing another structured search of the group tree structure to determine the final placement of the components thereof based on at least one of the widths and heights of the components.

25. The method of claim 24, further including:

performing at least one structured search of the tree structure to determine the initial placement of the group tree structure on the first side, the second side or both sides of the global symmetry line based on the tagging of the group tree structure; and

performing another structured search of the tree structure to determine the final placement of the group tree structure.

26. The method of claim 24, further including substituting the final placement of the components of a group tree structure for the final placement of the group tree structure.

27. A computer-implemented method for determining component placement in a circuit comprising:

(a) forming in the memory of the computer a tree structure that defines the placement of each of a plurality of components associated with the tree structure on a first side, a second side, or symmetrically on both sides of a symmetry line, with at least one component tagged for symmetric placement on both sides of a symmetry line;

(b) performing at least one search of the tree structure to determine an initial placement of a subset of the components on the first side, the second side, or on both sides of the symmetry line; and

(c) performing another search of the tree structure to determine a final placement of the subset of components, wherein at least a part of each component tagged for symmetric placement is positioned on each side of the symmetry line.

28. The method of claim 27, wherein each search is a depth-first search.

29. The method of claim 27, wherein:

the tree structure has a leaf for each component and at least one node connecting the leaves; and

the initial placement of the components occurs as a function of a vertical or horizontal line associated with at least one of a root node and an interior node of the tree structure.

30. The method of claim 27, wherein the symmetric placement includes one of:

pair-symmetric placement;

self-symmetric placement; and

asymmetric placement.

31. The method of claim 29, further including:

(d) forming a new tree structure in at least one of the following manners:

(1) changing a direction of a line associated with at least one of the nodes of the tree structure;

(2) amending the tree structure to re-define the placement of at least one component from one side of the symmetry line to the other side of the symmetry line;

(3) exchanging the location of two leaves in the tree structure;

(4) exchanging the location of two nodes in the tree structure;

(5) exchanging the location of a leaf and a node in the tree structure; and

(6) exchanging the width and height of a component associated with a leaf of the tree structure;

and

(e) repeating steps (b) and (c) for the new tree structure.

32. The method of claim 31, further including:

repeating steps (d) and (e) a plurality of times;

determining for each tree structure a cost that is related to the goodness of the final placement of the subset of components made utilizing said tree structure; and

selecting for implementation the final placement of the subset of components made utilizing the tree structure having the most favorable cost associated therewith.

33. The method of claim 32, wherein the cost for each tree structure is a ratio of (1) a total area of the subset of components in the final placement and (2) a total area of a rectangle that bounds the subset of components in the final placement.

34. A computer readable medium having stored thereon instructions which, when executed by a processor, cause the processor to perform the steps of:

(a) receive data regarding a plurality of components, with the data for each component having associated therewith a width, a height and one of a symmetric and a non-symmetric placement constraint for the component;

(b) create a tree structure that expresses the placement constraints for the plurality of components, the tree structure including:

a global root node that represents a global symmetry line,

a leaf representing each component, with the component associated with each leaf tagged for placement on a first side, a second side, or on both sides of the global symmetry line, and

at least one interior node that represents a slicing line that establishes a relative placement of at least two components with respect to each other on the same side of the global symmetry line;

(c) perform at least one structured search of the tree structure to determine the initial placement of components on the first side, the second side or both sides of the global symmetry line based on the tagging of each component; and

(d) perform another structured search of the tree structure to determine the final placement of components based on at least one of the widths and heights of the components.

35. A computer readable medium having stored thereon instructions which, when executed by a processor, cause the processor to perform the steps of:

(a) receive data regarding a plurality of components, with the data for each component including one of a symmetric and a non-symmetric placement constraint for the component;

(b) create a tree structure that expresses the placement constraints for the plurality of components, the tree structure including a plurality of nodes and a plurality of leaves wherein:

the plurality of nodes includes a global root node that represents a global symmetry line and at least one local root node connected to the global root node,

the local root node represents a local symmetry line,

a group tree structure includes the local root node and at least one leaf connected thereto, where the group tree structure is tagged for placement on a first side, a second side or on both sides of the global symmetry line, and

each leaf represents one of the components, with the component associated with each leaf of the group tree structure tagged for placement on a first side, a second side or on both sides of the local symmetry line, with the component associated with each leaf of the group tree structure having at least one of a height and a width associated therewith;

(c) perform at least one structured search of the group tree structure to determine the initial placement of components thereof on the first side, the second side or both sides of the local symmetry line based on the tagging of each component; and

(d) perform another structured search of the group tree structure to determine the final placement of the components thereof based on at least one of the widths and heights of the components.

36. A computer readable medium having stored thereon instructions which, when executed by a processor, cause the processor to perform the steps of:

(a) form in the memory of the computer a tree structure which defines the placement of each of a plurality of components associated with the tree structure on a first side, a second side or symmetrically on both sides of a symmetry line, with at least one component tagged for symmetric placement on both sides of a symmetry line;

(b) perform a search of the tree structure to determine an initial placement of a subset of the components on the first side, the second side or on both sides of the symmetry line; and

(c) perform another search of the tree structure to determine a final placement of the subset of components, wherein at least one of a copy of or a part of each component tagged for symmetric placement is positioned on each side of the symmetry line.

37. The method of claim 36, wherein the instructions further cause the processor to perform the steps of:

(d) form a new tree structure in at least one of the following manners:

(1) amend component placement information associated with at least one of the nodes of the tree structure;

(2) amend the tree structure to re-define the placement of at least one component from one side of the symmetry line to the other side of the symmetry line;

(3) exchange the positions of two leaves in the tree structure;

(4) exchange the positions of two nodes in the tree structure;

(5) exchange the positions of a leaf and a node in the tree structure; and

(6) exchange a width and a height of a component associated with a leaf of the tree structure; and

(e) repeat steps (b) and (c) for the new tree structure.

38. The method of claim 37, wherein the instructions further cause the processor to perform the steps of:

repeat steps (d) and (e) a plurality of times;

determine for each tree structure a cost that is related to the goodness of the final placement of the subset of components made utilizing said tree structure; and

select the final placement of the subset of components made utilizing the tree structure having the most favorable cost associated therewith.